What did we learn from the Internet 1996 World Exposition

A. Blanc[a,1], R. Blokzijl[a], H. van Dompseler[a,1],
W. van Leeuwen[a], C. Malamud[b], R. Spier[a,1], P. Tabaux[a]

[a] *National Institute for Nuclear Physics and High Energy Physics (NIKHEF), P.O. Box 41882, NL 1009 DB Amsterdam*

[b] *Massachusetts Institute of Technology (MIT), Room E15-429, 20 Ames Street, Cambridge, Massachusetts, 02139-4307 USA*

1 Introduction

The previous Computing in High Energy Physics conference, held in October 1995 in Rio de Janeiro, opened with a keynote speech from Carl Malamud, presenting a new project that aimed to establish a world's fair on the Internet in 1996: the "Internet 1996 World Exposition".

In this paper we give a short report on the results of this project, where we will put some emphasis on the activities of the NIKHEF team involved. We will also give a short description of the infrastructure we build for the Exposition and the various technologies used to integrate the system into one uniform, global service. Finally we will discuss some of the lessons learned during the course of this project.

2 Goals

When we set out to build a World Exposition on the Internet we had a set of well defined goals that we wanted to accomplish. We wanted to create a range of activities that would raise the awareness of the Internet to a large and broad audience. These activities can be listed as follows:

[1] Now at Tribute MultiMedia B.V.

a. Pavilions - A pavilion is a place on the Exposition where information is displayed. It can be a web-site, or a radio station, or an educational programme: anything.

b. Events - An event takes place in the real world. The challenge is to represent this in real time in the best possible way on the Internet, using all available technology. An additional challenge is to do this on a globally distributed platform.

c. Places - These are places in the real world where the Internet is added to an already existing environment. This could be a public terminal in a library, or in a railway station. It could also be connecting the Internet to a high tech billboard.

Of course the most important goal was to try and attract a wide participation from the general public.

3 Infrastructure

The infrastructure of the World Exposition consisted of two elements:

a. Central Park was the name we adopted for the set of dedicated computers that supported all of the activities. At the end of 1996 we had centers operational in Amsterdam, London, Hanover, Washington, Adelaide, Tokyo, Seoul and Taipei; with an additional machine installed early 1997 in Moscow. Most of these machines were donated especially for the project; in a few cases we got the use of existing machines which we upgraded.

As an example of a local server we can mention the Amsterdam machine which consists of a Sun Sparc 1000, with 8 CPU's, 1 Gbyte of RAM memory and 300 Gbyte of disc space. This machine is surrounded by two additional Sun 4's, 2 SGI Indy's and 6 200 MHz Pentium's for development and special services.

Globally, we had as a server platform a set of machines consisting of 6 Sun's, 1 SGI, 1 IBM SP2 and 1 Siemens, with a total of 5 Tbyte of disc space.

The glue that made this set of servers into one server consisted of an elaborate construct of Perl scripts that kept track of local modifications in filesystems, and which drove FTP sessions to keep a full dataset on each machine.

Last, but not least, only one address was published for the fair: park.org which could point to any one of the machines. It would lead to a Web page which has a script behind it that determines from which country a visitor is coming to the fair, and will redirect the link to an appropriate server in the region of the visitor.

b. Internet Railroad was the name for one of the most ambitious goals we set ourselves: a backbone network of 45 Mbits/second that would interconnect all of the Central Park machines. One should realize that at the time when this plan was conceived international connections of this bandwidth did not exist on the Internet, let alone intercontinental ones.

It is clear that there is only one source for such type of networking: the international telecommunications industry; both the technological capacity and the financial capability. After lengthy discussions with many carriers we succeeded in installing and operating our Railroad between Washington DC, Tokyo, Taipei and Seoul.

The Railroad was mainly used for data mirroring between the servers connected, and for special events where high quality audio and video streams were distributed.

4 Results

After the closure of the fair we did an elaborate analysis of the combined logfiles of our servers: 12 Gbyte of logging data. We will present the results in terms of the goals we set ourselves.

a. Pavilions: at the end of the project we had slightly over 4000 pavilions on line in Central Park. These came from 85 countries and ranged from submissions by individuals to very sophisticated corporate web sites built especially for the fair.

b. Events: we succeeded in featuring many special events. These were of a wide variety in nature: from religious street festivals in Singapore to rock concerts in Amsterdam; from Brain Opera's in the USA and Japan to the Atlanta 1996 Olympics. From a car rally in Mongolia to the Kasparov vs Deep Blue chess match.

c. Places: this worked in some countries - by far not all. The best result has been achieved in Taiwan, were our local team succeeded to interest the local industry to donate 1,500 PC's, and the local telecommunications company to donate the networking. This resulted in public access to the Internet in such widely varying places as railway stations, museums, libraries, shops, etc. The local sponsors viewed it as a great success, and will keep the programme running in 1997 for an additional 4,500 terminals. Places like Amsterdam, Seoul and Tokyo also took part in this aspect of the fair.

It has become increasingly popular on the Internet to quote the success of a service by publishing hit rates on Web pages. We concluded that this results in highly inflated numbers that in no way reflect the actual use of any particular service. We therefore express our popularity in Disneyworld units: visitors and tickets sold. Analysis of the logging files of Central Park showed that we attracted 5 million distinct visitors. coming from 128 countries, who paid 52 million visits to the fair.

5 Lessons learned

As with any complex project, a lot of the backstage technology has been developed while running the fair. Some of the technical issues that constantly needed attention were the following.

1. The mirroring of the data across all the servers suffered badly from the instabilities of parts of the Internet. Clearly, more sophisticated mechanisms than the ones we used are needed for large scale global data mirroring.

2. The automatic redirection of visitors to a suitable server in their geographical region showed to be extremely useful. However the way it was implemented by way of a cgi-bin behind a Web page appeared to be somewhat cumbersome in practice.

3. The distribution of audio and video data, especially from live events, needed a lot more attention than we anticipated.

These issues are part of a research and development effort now, in which most of the technical teams of the fair participate. This project is called Central Park and will run for the whole of 1997.

The participation of NIKHEF, an institute for Particle Physics, in this project produced some unexpected results for the institute. In the first place we acquired about US$ 1M worth of equipment from industry. This was complimented with a grant of about US$ 1M from Dutch national and local government agencies.

Equally important, NIKHEF generated through its participation in the fair a lot of publicity for the institute. Throughout the year we have been working together with a large number of organizations in the Netherlands who came to know NIKHEF as a center of excellence - and not only in particle physics. One example of this has been the provision of a 2 Mbit/second network connection last year for the CERN School of Computing which took place in the

Netherlands. We had learned by that time how to convince PTT's to donate advanced services.

6 Acknowledgments

The Internet 1996 World Exposition would not have been possible without the participation of thousands of volunteers, and the cooperation with governments and industry. The total amount received from the latter in money and in kind comes close to US$ 100M.

We would like to acknowledge especially the participants in Central Park and the Internet Railroad: Sun Microsystems, IBM, Auspex, Siemens, Quantum, Bay Networks, MCI, KDD, NTT, Chunghwa Telecom and Korea Telecom.